

CLAIMS

1 What is claimed is:

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3 1. An optical apparatus, comprising:

4 a) an input port, providing a multi-wavelength optical signal;

5 b) a wavelength-disperser that separates said multi-wavelength optical signal by
6 wavelength into multiple spectral channels having a predetermined relative
7 arrangement;

8 c) an array of beam-manipulating elements positioned to correspond with said
9 spectral channels; and

10 d) an optical detector;

11 wherein said beam-manipulating elements are individually controllable, so as to
12 direct said spectral channels into said optical detector in a time-division-multiplexed
13 sequence.

14

1 2. The optical apparatus of claim 1 wherein said beam-manipulating elements comprise
2 micromirrors.

1 3. The optical apparatus of claim 2 wherein said micromirrors comprise silicon
2 micromachined mirrors.

1 4. The optical apparatus of claim 2 wherein each micromirror is pivotable about at least
2 one axis.

1 5. The optical apparatus of claim 1 wherein said beam-manipulating elements comprise
2 MEMS shutter-elements.

1 6. The optical apparatus of claim 1 wherein said beam-manipulating elements comprise
2 liquid crystal shutter-elements.

- 1 7. The optical apparatus of claim 1 wherein said wavelength-disperser comprises an
2 element selected from the group consisting of ruled diffraction gratings, curved
3 diffraction gratings, holographic diffraction gratings, echelle gratings, transmission
4 gratings, and dispersing prisms.
- 1 8. The optical apparatus of claim 1 wherein said optical detector comprises an element
2 selected from the group consisting of PN photo detectors, PIN photo detectors, and
3 avalanche photo detectors.
- 1 9. The optical apparatus of claim 1 wherein said input port comprises a fiber collimator,
2 coupled to an input optical fiber transmitting said multi-wavelength optical signal.
- 1 10. The optical apparatus of claim 9 wherein said input optical fiber is a single mode
2 fiber.
- 1 11. The optical apparatus of claim 1 further comprising a beam-focuser for focusing said
2 spectral channels into corresponding focused spots that impinge onto said beam-
3 manipulating elements.
- 1 12. The optical apparatus of claim 1 further comprising a reference signal, emerging from
2 said input port along with said multi-wavelength optical signal; and a reference-
3 position-sensing element, wherein said wavelength-disperser directs a reference
4 spectral component of said reference signal to a predetermined location on said
5 reference-position-sensing element.
- 1 13. The optical apparatus of claim 12 wherein said reference-position-sensing element
2 comprises an element selected from the group consisting of position sensitive
3 detectors, quadrant detectors, and split detectors.
- 1 14. The optical apparatus of claim 12 wherein said input port comprises a fiber collimator
2 coupled to an input optical fiber, wherein said optical apparatus further comprises an

3 optical combiner for coupling a reference light source to said input optical fiber, and
4 wherein said input optical fiber transmits said multi-wavelength optical signal and
5 said reference light source provides said reference signal.

1 15. The optical apparatus of claim 12 further comprising an alignment-adjusting element
2 for adjusting an alignment between said spectral channels and said beam-
3 manipulating elements.

1 16. The optical apparatus of claim 15 wherein said beam-manipulating elements and said
2 reference-position-sensing element form an optical-element array, and wherein said
3 alignment-adjusting element comprises an actuation device coupled to said optical-
4 element array, for causing said optical-element array to move.

1 17. The optical apparatus of claim 15 further comprising a processing element in
2 communication with said alignment-adjusting element and said reference-position-
3 sensing element, wherein said processing element monitors an impinging position of
4 said reference spectral component onto said reference-position-sensing element and
5 provides control of said alignment-adjusting element accordingly, so as to maintain
6 said reference spectral component at said predetermined location, thereby ensuring a
7 requisite alignment between said spectral channels and said beam-manipulating
8 elements.

1 18. An optical apparatus, comprising:

- 2 a) an input port, providing a multi-wavelength optical signal;
- 3 b) a polarization-separating element that decomposes said multi-wavelength
4 optical signal into first and second polarization components;
- 5 c) a polarization-rotating element that rotates a polarization of said second
6 polarization component by approximately 90-degrees;
- 7 d) a wavelength-disperser that separates said first and second polarization
8 components by wavelength respectively into first and second sets of optical
9 beams;

- 10 e) a beam-focuser that focuses said first and second sets of optical beams into
11 corresponding focused spots;
12 f) an array of beam-manipulating elements positioned to correspond with said
13 first and second sets of optical beams; and
14 g) at least one optical detector;
15 wherein said beam-manipulating elements are individually controllable, such that
16 first and second optical beams associated with each wavelength are directed into said
17 at least one optical detector in a time-division-multiplexed sequence.

1 19. The optical apparatus of claim 18 wherein said beam-manipulating elements comprise
2 micromirrors.

1 20. The optical apparatus of claim 19 wherein said micromirrors comprise silicon
2 micromachined mirrors.

1 21. The optical apparatus of claim 19 wherein each micromirror is pivotable about at
2 least one axis.

1 22. The optical apparatus of claim 18 wherein said beam-manipulating elements comprise
2 liquid crystal shutter-elements.

1 23. The optical apparatus of claim 18 wherein said beam-manipulating elements comprise
2 MEMS shutter-elements.

1 24. The optical apparatus of claim 18 wherein said polarization-separating element
2 comprises an element selected from the group consisting of polarizing beam splitters
3 and birefringent beam displacers.

1 25. The optical apparatus of claim 18 wherein said polarization-rotating element
2 comprises an element selected from the group consisting of half-wave plates, liquid
3 crystal rotators, and Faraday rotators.

- 1 26. The optical apparatus of claim 18 wherein said wavelength-disperser comprises an
2 element selected from the group consisting of ruled diffraction gratings, holographic
3 diffraction gratings, echelle gratings, curved diffraction gratings, transmission
4 gratings, and dispersing prisms.
- 1 27. The optical apparatus of claim 18 wherein said beam-focuser comprises at least one
2 focusing lens.
- 1 28. The optical apparatus of claim 18 wherein said input port comprises a fiber
2 collimator.
- 1 29. The optical apparatus of claim 18 wherein said at least one optical detector comprises
2 a single optical detector.
- 1 30. The optical apparatus of claim 18 wherein said at least one optical detector comprises
2 first and second optical detectors, configured to receive said first and second sets of
3 optical beams, respectively.
- 1 31. The optical apparatus of claim 18 wherein said at least one optical detector comprises
2 at least one element selected from the group consisting of PN photo-detectors, PIN
3 photo detectors, and avalanche photo detectors.
- 1 32. A method of spectral power monitoring using a time-division-multiplexed scheme,
2 comprising:
3 a) providing a multi-wavelength optical signal;
4 b) separating said multi-wavelength optical signal by wavelength into multiple
5 spectral channels; and
6 c) directing said spectral channels into an optical detector in a time-division-
7 multiplexed sequence.

1 33. The method of claim 32 wherein said spectral channels are directed into said optical
2 detector sequentially.

1 34. The method of claim 32 further comprising the step of grouping said spectral
2 channels into a plurality of spectral sets, each containing one or more spectral
3 channels, whereby said spectral sets are directed into said optical detector in said
4 time-division-multiplexed sequence.

1 35. The method of claim 32 wherein said step c) is carried out by way of an array of
2 micromirrors that are individually movable.

1 36. A method of optical spectral power monitoring, comprising:
2 a) providing a multi-wavelength optical signal;
3 b) decomposing said multi-wavelength optical signal into first and second
4 polarization components;
5 c) rotating a polarization of said second polarization component by
6 approximately 90-degrees;
7 d) separating said first and second polarization components by wavelength
8 respectively into first and second sets of optical beams;
9 e) focusing said first and second sets of optical beams into corresponding
10 focused spots;
11 f) impinging said first and second sets of optical beams onto an array of beam-
12 manipulating elements; and
13 g) individually controlling said beam-manipulating elements, whereby first and
14 second optical beams associated with each wavelength are directed into at
15 least one optical detector in a time-division-multiplexed sequence.

1 37. The method of claim 36 wherein said at least one optical detector comprises a single
2 optical detector, and wherein said step g) comprises directing said first and second

3 optical beams associated with each wavelength into said optical detector
4 concurrently.

1 38. The method of claim 36 wherein said at least one optical detector comprises first and
2 second optical detectors, and wherein said step g) comprises directing said first and
3 second sets of optical beams into said first and second optical detectors, respectively.

TO THE COURT